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APPRENTICESHIP--A THEORETICAL MODEL.

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DESCRIPTORS- *APPRENTICESHIPS, *EMPLOYMENT PATTERNS, *EMPLOYMENT TRENDS, *MATHEMATICAL MODELS, AUSTRALIA,

AN INQUIRY INTO RECRUITMENT OF APPRENTICES TO SKILLED TRADES IN WESTERN AUSTRALIA INDICATED LITTLE CORRELATION BETWEEN THE NUMBER OF NEW APPRENTICES AND THE LEVEL OF INDUSTRIAL EMPLOYMENT OR THE TOTAL NUMBER OF APPRENTICES. THIS ARTICLE ATTEMPTS TO OUTLINE A MATHEMATICAL MODEL OF AN APPRENTICESHIP SYSTEM AND DISCUSS ITS IMPLICATIONS. THE MODEL, A FORMULA USING "TOTAL NUMBER OF APPRENTICES," "EMPLOYMENT," "APPROPRIATE APPRENTICE-EMPLOYMENT RATIO," "COEFFICIENT OF OPTIMISM," "LEVEL OF INTAKE," "QUALIFIED RECRUITS," AND "TIME" SHOWED A HIGH DEGREE OF AGREEMENT BETWEEN ACTUAL AND CALCULATED APPRENTICE INTAKE WHEN APPLIED TO THE MOTOR VEHICLE REPAIR AND CLOTHING MANUFACTURING INDUSTRIES FOR THE PERIOD 1948 TO 1958. IMPLICATIONS OF THE MODEL ARE--(1) COMPARATIVELY SMOOTH CHANGES IN INDUSTRY EMPLOYMENT CAN GIVE RISE TO LARGE APPRENTICE INTAKE CHANGES THUS CAUSING DIFFICULTIES IN THE FORMAL EDUCATION OF APPRENTICES, (2) CHRONIC SHORTAGES OF APPRENTICES WILL OCCUR IN OCCUPATIONS FOR WHICH SUPPLY LIMITATIONS PREVENT "NATURAL" INTAKE PEAKS FROM BEING ACHIEVED, AND (3) THE VIRTUAL IMPOSSIBILITY OF DISCHARGING AN APPRENTICE RESULTS IN A LOW "COEFFICIENCY OF OPTIMISM" WHICH MAY RESULT IN A LOWER INTAKE THAN OBJECTIVE CONSIDERATION WOULD JUSTIFY. THE IMPLICATIONS SUGGEST THE NEED FOR FLEXIBLE APPRENTICESHIP ARRANGEMENTS SUCH AS MAKING THE FIRST PART OF APPRENTICESHIP COMMON TO A NUMBER OF TRADES, OR INDENTURING APPRENTICES TO AN APPRENTICESHIP BOARD RATHER THAN TO INDIVIDUAL, THUS MAKING TRANSFER POSSIBLE. THIS ARTICLE IS A REPRINT FROM THE "BRITISH JOURNAL OF INDUSTRIAL RELATIONS," VOLUME 5, MARCH 1967. (EM)

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APPRENTICESHIP – A THEORETICAL MODEL

N. F. Dufty*

An inquiry into recruitment to the skilled trades in Western Australia through the apprenticeship system showed that the number of apprentices fluctuated more than industrial employment and the number of new apprentices fluctuated more than the total number of apprentices. Over the 1948/58 period the four quarter moving average figure for industrial employment showed one peak, the total number of apprentices had three peaks, and the figure for new apprentices showed nine peaks. Studies of particular industries revealed a similar pattern. In this article an attempt will be made to outline a theoretical model of an apprenticeship system and to discuss the implications of such a model.

The Model

Entrants to the apprenticeship system may be limited by supply or demand and in order to study first the demand side alone it was necessary to select industries in which there was a steady over-supply of entrants over the period in question. Further, in order to obtain comparable employment figures it was essential to select industries whose boundaries coincided as closely as possible with particular occupations. The trades fulfilling these requirements over the 1948/58 decade were those of plumber, carpenter, painter, motor mechanic and tailor. The rank order correlations between the total number of apprentices and employment ranged from 0·85 to 0·94 whereas those between entrants and employment were from 0·36 to 0·81. Other relationships tested, such as earnings, wage rates, etc., showed correlations approximating to zero. On the basis that the stable relationship is between the total number of apprentices, A, and employment in the industry, E, this may be expressed for period t in the form

$$A_t = KE_t$$

when K is the appropriate apprentice/employment ratio. Assuming a stable relationship between the number of tradesmen and industry employment, the upper limit of K will be set by the limiting apprentice/tradesmen ratio determined by the industrial tribunal. In practice this is not a restrictive factor, at least on an industry basis.

The operation of the industrial tribunal is such that it is extremely difficult for an employer to discharge an apprentice. The level of employ-

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ment relevant to the model will therefore be the sum of all the firms' minimum anticipated employment figures for some years ahead. Employers are unlikely to take the risk of being caught with too many apprentices if economic conditions make it necessary for them to reduce employment. If we take C to be a coefficient of optimism then the relationship becomes

$$A_t = KCE_t$$

The level of intake will be determined by A less the apprentices still in training, the latter being largely dependent on the intake in previous years after allowing for wastage. If I is the annual intake and a, b, c and d are coefficients describing the retention of the intake after 1, 2, 3 and 4 years then

$$I_t = KCE_t - aI_{t-1} - bI_{t-2} - cI_{t-3} - dI_{t-4}$$

In most trades the ability to absorb first year apprentices is limited, this limit being set by technical factors and being high for trades such as wood-machining and low for others such as watch repairing. If the first year apprentice ratio is denoted by K^1 then

$$I_{t\,max} \leqslant K^1E_t$$

Finally, the annual intake will not exceed the supply of suitably qualified recruits, S_t that is

$$I_t \leqslant S_t$$

The significant feature of such a model is that even smooth movements in industry employment are likely to generate wide and persistent fluctuations in the annual intake of apprentices. For example, taking c, a, b, c, d, to be unity, K as 0·20 and both K^1 and S as non-limiting, then a rise of employment from 400 to 540 at twenty per annum followed by six years at that figure and a decline back to 400 at the same rate will generate intake fluctuations from twelve to twenty-four and will show three peaks.

The Model in Operation – Western Australia

Two industries are taken as examples, both of them with an ample supply of recruits relative to demand, in order to prevent supply becoming a limiting factor. In the first one, the motor vehicle repair industry K = 0·092, K^1 and S are non-limiting, and the intake figures for the four previous years are assumed to be 32, 50, 99 and 67. Actual figures are not used in either example because of the distortion of the overall picture caused by the training of men from the armed services. The data indicate a wastage rate of 10 per cent per annum, a, b, c and d are therefore taken to be 0·90, 0·80, 0·70 and 0·60 respectively. Values of C are purely subjective estimates, unity for the first eight years of the decade then 0·92 and 0·87 in the last two. The data are shown in the table below.

TABLE 1

Employment, Actual and Calculated Apprentice Intake Figures, Motor Vehicle Repair and Clothing Industries, Western Australia, 1948/49 to 1957/58

	Motor Vehicle Repair			*Clothing*		
Year	*Employment*	*Apprentice Intake*		*Employment*	*Apprentice Intake*	
		Actual	*Calculated*		*Actual*	*Calculated*
1948/49	2622	47	47	1328	33	33
1949/50	2847	66	66	1351	59	59
1950/51	3132	84	84	1447	34	34
1951/52	3212	93	93	1318	35	35
1952/53	3590	93	105	1068	16	15
1953/54	3839	84	85	1043	19	19
1954/55	4152	104	106	947	10	10
1955/56	4252	108	100	825	10	9
1956/57	4290	63	63	738	20	25
1957/58	4425	91	91	677	7	9

Taking a different industry, clothing manufacture, which shows a different employment trend, K = 0·18, K^1 and S are non-limiting, and the intake figures used are 54, 18, 64 and 70 for the four years prior to 1948/49. No resignations were reported, therefore a, b, c and d are taken as unity. After 1951/52 employment in the industry fell heavily due to inter-state competition and the industry suffered severely. Estimates for C are therefore unity for the first four years of the period followed by 0·92, 0·87 and 0·67 for the next three and 0·60 for the rest of the decade. The results are shown in the table above.

IMPLICATIONS OF THE MODEL

On the evidence presented above, the suggested model of an apprenticeship system approximates to the real situation, at least in the particular labour market under consideration. The implications of the model may be enumerated as follows:

1. Comparatively smooth changes in industry employment can give rise to quite large fluctuations in apprentice intake. These cause organizational difficulties for the authorities responsible for the formal education of apprentices.
2. In occupations which find it difficult to attract recruits, supply limitations prevent 'natural' intake peaks being achieved. This inability to make up for the lean years is likely to result in a chronic shortage of apprentices.[1]
3. The institutional factors involved, principally the virtual impossibility of discharging an apprentice, result in comparatively low values for the coefficient C. Employers with a pessimistic outlook on their future operate on a low C. Although this may be compensated

[1] For a more detailed consideration of this point in a specific employing authority see N. F. Dufty, 'The Influence of the Selection Process and Labour Market Pressures on Recruits to the Skilled Trades', *Journal of Industrial Relations*, 7, 1965, 336–340.

by high values of C for other employers in the industry whose future prospects are brighter, K[1] or S may be limiting factors. The net result is a lower level of intake of apprentices into the industry as a whole than an objective consideration of all the factors would justify.

The implications outlined above suggest certain modifications to the system which might help to correct some of the observed unbalances. The most important of these would be the introduction of some flexibility into the arrangements. One way in which this could be done would be to make the first part of the apprenticeship common to a number of related trades, thus enabling transfers to be made, at least in the early stages of training. In order to overcome the reluctance of employers to take reasonable numbers of apprentices (a reluctance which stems from the perceived danger of a reduction in employment) it would also be advisable to indenture apprentices to an Apprenticeship Board rather than to individual employers. This would facilitate inter-employer transfers when a particular industry, or some portion of it, was adversely affected by economic conditions. It may even be feasible for the government to take final responsibility in circumstances where transfers were impossible. Of course, the above comments are no more than tentative ideas which would need further consideration in the institutional context of the labour market concerned.[2]

[2] For a more detailed discussion see N. F. Dufty, 'Apprenticeship', *Economic Activity in Western Australia*, 9, 1966, 13–20, also reprinted in W. G. Ford and J. E. Isaac (eds.) *Readings in Australian Industrial Relations* (Sydney: Sun Books, 1967).